ENVIRONMENTAL ASSESSMENT

SOUTHERN CALIFORNIA CHEMICAL CO., INC.

SANTA FE SPRINGS, CALIFORNIA

3/90

March, 1986

Prepared by:

J. H. Kleinfelder & Associates
901 W. Victoria Street, Suite G
Compton, California 90220

J. H. KLEINFELDER & ASSOCIATES
GEOTECHNICAL CONSULTANTS • MATERIALS TESTING
LAND AND WATER RESOURCES

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SOUTHERN CALIFORNIA CHEMICAL CO., INC.
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1.0 INTRODUCTION

This report presents the work and findings of the environmental assessment performed on the Santa Fe Springs facility of Southern California Chemical Co., Inc. (SCC). The work has been coordinated with Ms. Tere King of Southern California Chemical Co., Inc., Santa Fe Springs, California.

A regional site plan illustrating the facility's location is presented on Plate No. 1. A site specific plan showing the study area is presented on Plate No. 2.

The original purpose of the investigation was to respond to the requests of the Los Angeles Regional Water Quality Control Board and the Department of Health Services concerning monitoring of the steel reinforced concrete wastewater pond per RCRA requirements. Once elevated levels of inorganic and organic were detected, the investigation was expanded to determine the vertical and horizontal extent of the contamination.

Southern California Chemical Co., Inc. has been located at its present address for over 25 years. The Santa Fe Springs facility is an original manufacturer of patented and proprietary inorganic chemicals for electronic and printed circuitry, plating, water treatment and agricultural uses. Chemicals manufactured on-site include: liquid copper sulfate; copper oxides; copper chlorides; ferric chlorides and other proprietary formulations including a line of patented ammoniacal and other etchants. Between 1977 and 1979, SCC discontinued the manufacture of zinc sulfate solutions. Chemicals currently used on-site in manufacturing processes include, but are not limited to, ammonia, iron, copper chemicals, hydrochloric acid, sulfuric acid and other inorganic compounds and elements.

2.0 AUTHORIZATION

The work on this project was authorized by Ms. King on a contract dated November 29, 1984.

3.0 SCOPE OF WORK

The scope of work on this project is outlined in our proposal dated November 26, 1984 as modified by the Regional Board in a letter dated December 11, 1984 and by our Work Plan dated May, 1985. The scope of work was developed through communication with Mr. Hank Yacoub and Mr. Athar Khan of the Los Angeles Region of the Regional Water Quality Control Board (RWQCB), and our understanding of the RCRA requirements. Specific work scope items are:

- o Drilling, sampling and logging 19 soil test borings to depths ranging between 15 and 110 feet.
- o Completing thirteen of these borings as monitoring wells.

- o Sampling and analyzing the water from each monitoring well.
- o Analyzing soil sampling from each boring.
- o Evaluating the collected data.
- o Preparation of a report.

4.0 FIELD INVESTIGATION

4.1 Soil Boring/Sampling

A total of 19 soil test borings were drilled. The locations are shown on Plates 2 and 3. The original work plan proposed that all wells would be drilled by the continuous flight hollow stem auger method. Due to artesian groundwater conditions, the use of hollow stem equipment beneath 45 feet was impossible. With the concurrence of the RWQCB, the borings were drilled by the hollow stem auger method for the upper 45 feet than converted to the mud rotary method for the remainder of the hole. The augers, drill rod and drill bits were steam cleaned prior to use and between borings to minimize the potential for cross contamination. The drilling was performed by Datum Exploration under the observations of a J. H. KLEINFELDER staff geologist who visually logged the borings and classified the soils. The boring logs are presented on Plate No.s 5 through 23 in the Appendix. Plate No. 4 illustrates the Unified Soils Classification System used to classify the soils encountered.

Soil samples were collected during the drilling operation at approximately 5 foot intervals in the unsaturated zone and then at stratagraphically significant intervals once groundwater was encountered. A modified Porter Sampler was used to collect samples. Soil samples were collected for both laboratory analysis and for visual classification of soil types. All retained soil samples were collected in brass sampling tubes, sealed with aluminum-lined caps, labeled and delivered to Brown and Caldwell Analytical Laboratory, Pasadena, California for chemical analysis, accompanied by the appropriate chain of custody form. Copies of the chain of custody forms are included in the Appendix C.

4.2 Monitoring Well Construction/Development

Thirteen of the soil test borings were completed as monitoring wells. Eleven of the wells were constructed with 2-inch diameter, NSF-rated pw, PVC pipe and 0.020-inch, machine-slotted screen. Two wells (numbers 4A and 9) were constructed with 4-inch diameter PVC pipe with 0.020-inch, machine-slotted screen. The screened section annulus was packed with clean sand and a bentonite plug was placed above the sand pack. The remaining annulus was cemented from the plug up to the surface. No solvents or glues were used during the well construction. The details of each individual well completion are shown on each respective boring log.

Each well was finished with either an aluminum well head box with a moisture and tamper-resistant lid or a locking, steel-cased well protector. The well head boxes are set 1 to 2 inches above ground level, with a finished cement apron to minimize the potential for entrance of surface fluids. These 3-foot-high well protectors were used on MW-5 and MW-4A to prevent contamination of these wells during flooding conditions.

After installation, the wells were developed with an air lift developing tool equipped with a foot valve to prevent the introduction of air into the formation. The wells were pumped until the water was relatively clear.

4.3 Water Sampling

All wells were measured for static water level prior to sampling. The wells were then purged and sampled using an air-activated submersible pump (bladder pump) constructed of stainless steel and silicon. To minimize the potential for cross-contamination, the pump and teflon sample line were thoroughly decontaminated before sampling and between wells by the following procedure:

1. Exterior surface of sampling tubes are decontaminated by steam cleaning during withdrawal from every well.
2. Sample pump is disassembled and the used bladder removed.
3. All pump components are then steam cleaned and rinsed in distilled water.
4. Pump is reassembled with a new bladder installed.
5. Teflon sampler lines are pressure-washed with 5 to 10 gallons of clean, hot water through direct connection to steam cleaner.

6. Five gallons of distilled water are then pumped through entire system.

Prior to sample collection, a minimum of five well volumes were purged from the well to collect a representative formation sample. Conductivity and pH measurements were taken at frequent intervals to ascertain the point at which values stabilize. Stabilized values indicate that representative formation fluids are being extracted from the well.

4.4 Monitoring Well Elevation

The location and elevation of the monitoring wells were determined by surveys made by Combs/Rodriguez & Associates Land Surveying, Cerritos, California on March 15, 1985 and on August 29, 1985.

Table A presents the well head elevations, depth to groundwater, perforated interest and groundwater elevations of the 13 monitoring wells. Plates 25 through 28 are generalized water level contour maps of the uppermost water bearing zone beneath the site for the period February, 1985 to October, 1985.

5.0 LABORATORY TESTING

Laboratory testing for Phase I of this project consisted of analyzing 12 soils samples and 6 water samples. Water from MW-6A was not analyzed since the RWQCB concurred that the limited amount of water present in this well (less than one liter) was not representative of the groundwater in this area. The soils were analyzed for the metals that have historically been used on the site. These metals are listed in Table C. The water samples were analyzed for: 1) The parameters that characterize the suitability of the groundwater as a drinking water supply as specified in 40 CFR, Part 265 Appendix III; 2) The parameters that establish the groundwater quality as specified in 40 CFR, Part 265.92 (b)(3); 3) The parameters used as indicators of groundwater contamination as specified in 40 CFR, Part 265.92 (b)(3); and 4) The compounds requested by DOHS and the RWQCB in their letter dated December 11, 1984, and 5) Compounds requested by SCC not included in the above. These parameters are listed in Table B.

Laboratory test for Phase II of this project consisted of analyzing 60 soil samples and 10 water samples. The soils were analyzed for the same metals as in Phase I. In addition, soil pH was measured. Also, half of the samples were analyzed for cadmium. Six water samples (one from each new well) were analyzed for groundwater indicator parameters as specified in 40 CFR part 265.92 (b)(3) and for the substances detected above drinking water standards during Phase I. These parameters are listed in Table B. The other four water samples that were collected during this phase were analyzed for purgeable organics.

The testing was performed at Brown and Caldwell Analytical Laboratory, Pasadena, California. The results of the laboratory testing are summarized and presented in Tables D through J and on

Plates 29 through 34. The laboratory data sheets are included in Appendix B. EPA method 624 was utilized for analysis of organic compounds. All other analyzes were performed by procedures outlined in the 15th Edition of Standard Methods.

In addition to the above laboratory testing, 29 soil samples were analyzed by Southern California Chemical, Inc.'s in-house laboratory for pH, chromium, copper and cadmium. The in-house laboratory results are presented on Plates 29 through 34 and included in Appendix B.

6.0 QUALITY CONTROL

To monitor the precision and accuracy of the chemical data, the following quality assurance measures were employed:

1. Duplicate samples
2. Split samples
3. Trip blank testing
4. Cross-contamination testing

Duplicate samples were taken at each sampling site. In the case of 40 ml VOA vials, four samples were obtained for each parameter as required in 40 CFR, Part 265.92 (b)(3). This ensures that if breakage or trouble with the testing equipment occurs, there is a backup sample test. This also allows a recheck on results if there is an inconsistency or if confirmation of results is necessary.

Trip blank; (distilled water) were included by the laboratory to monitor quality control during transportation and testing of the samples. Split samples were provided to both the Regional Board and Southern California Chemical Co., Inc. Due to the discoloration of the sample from MW-4, all three laboratories analyzed this sample. Comparison of the chromium results of this sample, the major chemical of concern, demonstrate the relative consistency of the ~~data~~. The Regional Board's laboratory detected 520 ppm of total chromium. Brown and Caldwell detected 520 ppm of total chromium. Southern California Chemical Co., Inc.'s in-house laboratory detected 520 ppm of total chromium in the groundwater. This consistency demonstrates a high level of confidence in the results.

To minimize cross-contamination between field samplings, the pump and sample lines were purged by the procedure detailed in Section 4.3 The total volume of pump and lines is less than one-half gallon. The pumping results in 20 to 26 volumes of clean water being flushed through the system. During Phase II, three quality control samples were analyzed to detect if cross-contamination was occurring. A review of Table I indicates that the above procedure has minimized cross-contamination.

All samples were labeled during sampling and shipped, refrigerated, to Brown and Caldwell Laboratories, Pasadena, California. A chain of custody form was maintained for all samples taken. Copies of these forms are included in Appendix C.

7.0 GEOLOGY/HYDROGEOLOGY

7.1 Geology

Southern California Chemical Inc.'s Santa Fe Springs facility is located in Section 31 of Township 2 South, Range 11 West (San Bernardino Base meridian), within the Santa Fe Springs Plain area of the coastal plain of Los Angeles County, California. The Santa Fe Springs Plains is a low, slightly rolling topographic feature that is a part of ~~has been warped by~~ the Santa Fe Springs-Coyote Hills anticlinal system. This plain dips gently both to the northeast toward Whittier and to the southwest toward the Downey Plain, with an elevation difference that ranges between 175 and 200 feet above sea level.

The site is located on upper Pleistocene alluvium of the Lakewood Formation. The Lakewood Formation unconformably overlies the lower Pleistocene San Pedro formation, the Pliocene Pico and Repetto formations, and the Miocene Puente formation. Beneath the site, only the Lakewood and the San Pedro formations contain fresh water bearing units (Plate 35).

7.2 Hydrogeology

The site area is located on surface exposure of the Bellflower Aquiclude, a low permeability portion of the Lakewood formation. This late Pleistocene alluvial formation is approximately 15 to 20 feet thick and consists of clays, silts, silty clays and sandy clays at this location. The Gage Aquifer underlies this and is approximately 15 to 20 feet thick, consisting of fine to medium sands in this area. This aquifer is dry beneath the SCC site. The literature (2) places the bottom of the Gage Aquifer at approximately 50 feet beneath the surface. On-site borings indicate that the bottom of the Gage is actually at approximately 30 to 35 feet. All the borings drilled on-site encountered a clay to silty clay layer beneath the Gage. This is most likely the top of the uppermost aquiclude of the San Pedro Formation. This aquiclude is approximately 15 to 25 feet thick and serves to separate the Gage Aquifer from the Jefferson Aquifer. The Jefferson Aquifer underlies this aquiclude and is the uppermost waterbearing aquifer beneath the site. All water samples were obtained from this aquifer. The general regional flow of groundwater in the area is to the south to southwest (3, 9). The water levels measured in the monitoring wells indicate a site-specific flow to the south-southwest. Plates 24 through 28 illustrate the approximate water level contours and flow direction based on the data generated during this study.

The following production wells are located within a one-mile radius of the site:

State Well Number	Owner
2S/11W - 29 E05	Apex Bulk Commodities Associates of Los Nietos
2S/11 - 30Q05	Mutual Water Owners Associates of Los Nietos
2S/11W - 30R03	City of Santa Fe Springs
3S/11W - 32J04	Whittier Union High School

The only chemical data available for the above wells is the General Mineral analysis for Well Number 2S/11W - 30R03. This analysis is included in Appendix B.

7.3 Aquifer Parameter Evaluation

An aquifer test was performed to evaluate the aquifer transmissivity, permeability and storage coefficient. These parameters were evaluated for subsequent use in predictive equations of aquifer yield and drawdown.

7.3.1 Step Drawdone Test

A step drawdown test was performed prior to the aquifer test to:

1. Determine the proper pumping rate for the aquifer test.
2. Observe pumping rate/drawdown relationships, and
3. Estimate specific capacities.

The test was performed on August 19, 1985 using monitoring well 9. A four-inch Goulds submersible pump was used for the test. The pump inlet was set at 65 feet depth. Drawdown in the pumping well was monitored with a conductivity-based water level indicator. A rotometer was used to monitor the discharge from the pump. Discharge from the pump was piped into a storage tank, treated, then piped into the sanitary sewer system.

Table K summarizes the data from the test. Plots of the time drawdown data measured in the tests are included in APpendix D. As shown in Table K, two pumping rates were used in the test.

The test was terminated after 110 minutes of pumping at up to 35 gpm.

7.3.2 Aquifer Test

The aquifer test was performed on August 29, 1985. The constant rate pumping test was conducted using monitoring well 9 for pumping and monitoring wells 4, 8 and 10 for drawdown monitoring. Water levels in the pumped well and the monitoring well were measured with a conductivity-based water level measurement indicator. Prior to the start of the test, water levels in all monitoring wells at Southern California Inc. were measured and recorded.

A four-inch Gould, submersible pump was used to pump an average of 25.4 gpm. The inlet of the pump was set at a depth of 65 feet. The discharge rate reading on the rotometer was checked by timing the filing of a barrel of known volume.

Pumping was carried out for 4 hours and 10 minutes, at which time near steady state was achieved in the pumping well and in the monitoring wells. Recovery was monitored and required 120 minutes in monitoring well 10.

The time-drawdown data from monitoring wells 4, 8 and 10 were plotted for analysis by the Theis curve matching and Jacob-Cooper approximation. The plots and subsequent calculations are shown in Appendix E of this report. Results of these analytical methods are summarized in Table L.

The results show transmissivity values ranging from 32,057 to 44,694 gpd/ft. The average value among these methods is 40,000 gpd/ft. Transmissivity was not calculated for the pumping well (MW-9) because of the scatter of the data points due to the turbulence caused by the pump.

Storage coefficient values range from 0.0061 to 0.010. These values generally indicate a confined aquifer condition.

During the pump test, the discharge started to decrease due to the increasing head in the storage tank and as a result of the pump overheating. In the calculations, one average discharge rate for the entire test.

7.4 Surface Water Features

Average rainfall for the Santa Fe Springs area is approximately 13 to 14 inches annually. Located 1/4 mile to the northeast is the Soreson Avenue storm drain. This concrete-lined channel is the only surface water feature within one mile of the facility. The San Gabriel River is slightly over one mile west of the facility. The associated percolation basins are located 1-1/2 to 2 miles northwest of the site. These streams are classified as intermittent, due to the semi-arid climate of Southern California.

8.0 HISTORY OF POND 1

Pond number 1 was a 36,000-gallon treatment pond located approximately in the center of the facility. The pond was constructed in 1975 of 6-inch, reinforced concrete. Company records indicate that the contents of the pond varied only slightly during the ten years of operation (Table M). Plate 35 presents the reactions, quantities and frequencies of chemicals used in pond 1. Sludge from this pond was periodically removed and disposed of in an approved facility. Representative hazardous waste monitoring of this sludge removed during the period December 1981 to present are included in Appendix F.

Reviewing the chemical reactions as outlined in Plate 36 indicate that the pH of the pond was maintained above 6, usually in the 12 to 13 range. The only exception to this was during the period between January, 1983 and August, 1984; chromic-sulfuric acid was added just prior (1/2 to 1 hour) to sludge removal. This mixing of pond sludge and acid was done to neutralize the acid so it would be accepted by the Class I landfill.

In August, 1985, use of the pond was discontinued. Inspection of the pond, after draining and cleaning, revealed no visible signs of leakage or of chemical degradation of the concrete. This was to be expected since the high pH of the pond precipitated gypsum upon the pond walls and bottom, further reinforcing the pond's seal.

$CaSO_4 \cdot 2H_2O$

9.0 CHEMICAL DATA

9.1 Groundwater Samples

Groundwater samples were collected from the Phase 1 monitoring wells (1, 2, 3, 4, 5 and 6) between February 21 and March 12, 1985. Representatives of the Regional Board and Southern California Chemical Inc. were present during sampling and were provided split samples, when requested.

Analyses of the water from these 6 monitoring wells are presented in Table F through Table H. The appropriate State or Federal Standard for each parameter is listed for comparison. All substances except for the following were below the applicable standards. Cadmium was detected in MW-4 at 0.78 mg/l. Chromium (Hexavalent) was detected at 500 mg/l in MW-4. Nitrate, both as No3 and N was detected in MW-4 at 81 mg/l and 18 mg/l respectively, in MW-4. Chloride was also detected in MW-4 at 2300 mg/l. Manganese was detected in 5 of the 6 wells at levels between 7.5 and 0.53 mg/l. Specific conductance was also detected above drinking water standards in 5 of the 6 wells.

It was evident from the data that chemical substances were present in the groundwater in the vicinity of Monitoring Well 4. Subsequently, the Phase II study was initiated.

Groundwater samples from the 6 new wells (4A, 7, 8. 9, 10 and 11) were collected between July 24, 1985 and August 30, 1985. Split samples were again provided to the Regional Water Quality Control Board and Southern California Chemical, Inc.

Analysis of the water from these six wells is presented in Table I. Cadmium and chromium are below drinking water standards for all Phase II wells. Nitrate as No3 was detected at 120 mg/l in monitoring well 17.

Specific conductance of all the wells except MW-4A are above drinking water standards. Based on previous work performed in the area, this is not uncommon for shallow aquifers in Los Angeles County. TOC was detected at levels up to 440 mg/l in MW-10, 260 mg/l in MW-7 and up to 210 mg/l in MW-9.

As a result of DOHS Laboratory's detection of organics, Southern California Chemical Co., Inc. resampled monitoring wells 2, 3, 4 and 5. The organic analysis, in addition to the levels detected by DOHS, are presented in Table J. Analysis indicates that elevated levels exist in monitoring well 4 with lower levels in the surrounding wells. In addition, organic chemicals were detected in MW-4 at levels up to 10 mg/l. The laboratory data reports are indicated in Appendix B.

9.2 Soil Samples

Seventy-two soil samples from the pond area were analyzed for pH, cadmium, chromium, copper, zinc, nickel, chloride, sulfate, ammonia nitrogen and carbonate. Forty-three of these samples were analyzed by Brown and Caldwell Laboratories. These are presented in Tables D and E. The other 29 samples were analyzed by Southern California, Inc.'s in-house lab. Soil concentrations are presented on Plates 29 through 34.

Chromium

Chromium values on-site range from 30,000 mg/kg to 3.7 (Plate 29). The high values were detected in the old underground storage tank area with values up to 30,000 mg/kg at 5 feet, decreasing to 3,000 mg/kg at 35 feet. Beneath the pond, values increase from the 50 mg/kg range at 10 feet to 2,000 mg/kg at 30 feet. The 10-foot samples on the site's perimeter ranged between 8.5 mg/kg and 35 mg/kg.

pH

Values for pH ranged between 3.1 and 8.7 in the study area (Plate 30). Values beneath the pond were significantly lower than levels detected around the pond. This is significant since the pH levels of the product in the pond were between 6 and 13 (see Section 10.2).

Copper

The level of copper detected on-site ranged between 13,000 mg/kg and 25 mg/kg on site. The higher levels (above 1,000 mg/kg) were detected in the old underground storage tank area. Beneath the pond, values ranged between 100 and 500 mg/l (Plate 31). The perimeter borings ranged between 63 mg/kg and 35 mg/kg except for the 10-foot sample of MW-11 where 2,400 mg/kg were detected.

Chloride

Chloride levels on-site ranged between 420 mg/kg and 5,500 mg/kg. The highest level was detected in slant boring 2, 35 feet beneath the pond. Chloride in the old underground storage tank area ranged between 1,100 and 1,800 mg/kg (Plate 22).

Other Substances

Analysis for cadmium, zinc, nickel, sulfate, ammonia nitrogen and carbonate were performed in selective samples. Except for the 15-foot sample of Boring 6, no significant levels of these substances were detected.

10.0 DISCUSSION

10.1 Water Quality

As part of Phase I of this study, seven monitoring wells were completed and sampled for all the RCRA requirements. Of all the monitoring wells, only one (MW-4) had levels of compounds above the Primary Drinking Water Standards. Chromium, cadmium and nitrates were detected in MW-4. A second phase of investigation was undertaken to determine the horizontal and vertical extent of the chemical constituents in the groundwater. Six additional monitoring wells (MW-4A, 7, 8, 9 and 10) were installed. After sampling these new wells, it was determined that nitrates exist above the Primary Drinking Water Standards or in MW-7. None of the other substances exist above the standards of these new wells, including chromium, cadmium or nitrates. Copper, the most common compound used on-site, has never been detected above standards in the groundwater.

Therefore, at present, nitrates exist above the Drinking Water Standards in the wells MW-7 and MW-4. The higher levels were detected in the up-gradient well MW-7. This suggests that mitrates are migrating onto the site. Elevated levels of cadmium and chromium were only detected in MW-4. This suggests that a small cadmium/chromium plume exists near monitoring well 4.

If it is assumed that the cadmium/chromium plume extends up to each of the nearest monitoring wells, the maximum north-south extent of the plume is 80 to 100 feet, while the maximum east-west dimension is 40 to 50 feet. The plume is therefore apparently contained within the site boundaries. In addition, the plume was not detected in MW-4A, which was screened at a deeper interval (87 to 107 feet) than MW-4 (45 to 75 feet). The top of the confined aquifer beneath the pond is at 55 feet. Assuming the chemical constituents extend vertically to just above the 87-foot level, the maximum plume thickness at MW-4 is approximately 32 feet.

During Phase I sampling, the Los Angeles Regional Water Quality Control Board (RWQCB) was provided split samples for analysis.

In addition to the RCRA substances, as outlined in the original study plan, the RWQCB analyzed for organic chemicals. The RWQCB analysis indicated the presence of toluene, xylene, ethylbenzene and a number of other organic compounds in the groundwater beneath the site. Southern California Chemical then resampled and verified these analyses.

Southern California Chemical Co., Inc. is solely an inorganic chemical manufacturer. Company records indicate that organic chemicals have never been used on-site, even in laboratory quantities. It should be noted that eight of the surrounding neighbors are organic chemical plants, and the are has been used for heavy industrial uses for at least 50 years. The plant area was, for many years prior to SCC's occupancy, owned and operated by Southern Pacific Railroad. It is not known how organic compounds have migrated into the water sampled at MW-4.

Review of company records indicates that the source of chromium in the water could be the result of one of three possibilities; the first is surface spillage before the plant was paved; the second is the wastewater pond; and the third is an underground storage tank that was removed 11 - 15 years previously and that apparently had leaked. As will be discussed in the next two sections, the possibility that surface spillage was the source is still unknown. The wastewater pond as the source is unlikely. The most likely source is the old tank area.

10.2 Soil Quality

In order to determine the source of the contaminated groundwater, an additional set of soil borings were drilled. Two of these borings (B1 and B2) were slant-drilled adjacent to and under the pond. The other four (B3, B4, B5 and B6) were drilled vertically to attempt to locate the site of the old underground tank (Plate 3). Company records indicated that this tank was located 40 to 50 feet to the northeast of pond number 1. This tank contained a low pH chrome etching solution which was a mixture of chrome, copper, chloride, ammonia, nitrogen and sulfate.

Review of the data in Tables D and E indicate elevated levels of chromium in the shallow soils at the site of the old tank. These levels decrease with depth, which suggests a surface or near-surface source existed/exists in this area. The data from borings B1 and B2 beneath the pond indicate that the chromium levels at the 10 foot depth are relatively low but the levels increase with depth. This suggests that the chromium is not coming from a surface source directly above this area, but is migrating from an outside source to the pond surface.

Analysis of the pH data from Table D and E provides a second and more convincing indicator that the chromium is apparently migrating to the pond surface from a source outside of the pond area. As discussed in Section 8.0, the liquid in the pond was maintained between pH 6 and 14. The pH values of the soil from borings B1 and B2 under the pond were neutral or acidic (pH 8-

3.9) at shallow depths, and decrease from pH 5.5 to 3.3 with increasing depth. This indicates that the low pH source is most likely migrating laterally under the pond from an outside source.

The pH of the old chromium tank was in the range of 1 to 3, which explains the low pH values in the tank area.

Copper is another element which, like chromium and pH, has higher levels in the old tank area and low levels in the pond area (in particular, in B6). Both were detected at only low levels beneath the pond.

Chloride is the only chemical that has higher values in the soils beneath the pond than in the tank area. This is to be expected and also consistent with the conclusions that the underground tank area is the source of the chloride, since chloride is the most soluble and conservative of the substances that were stored in the old tank and would have been easily displaced in the near surface by soil moisture migration once the source was removed.

10.3 Vadose-Zone Transport

Migration of contaminants from the old tank area to the pond subsurface likely occurred as unsaturated-zone migration, which is dissimilar to the forces governing saturated-zone migration. Capillary forces and gravitational attractions predominate, resulting in a downward migration except on those areas where fine-grained materials (silts and clays) overlie clean sands. In this case, capillary forces resist the vertical drainage from the fine-grained material until the field capacity of the material is exceeded, at which time a "breakthrough" of fluid will migrate downward through the sand to form a perched layer at the sand base. This explains the observed presence of high levels of *I must have missed it.* chromium in the fine-grained layers, low levels in the upper portions of the sand layer and high levels at the base of the sand. *excellent resolution considering that smpls were collected at 5' intervals.*

Carbonate material present in the silts and sands have reacted with acidic material in the seepage to sequentially precipitate copper, but not hexavalent chromium. *Again, excellent resolution*

11.0 CONCLUSIONS

The following general conclusions can be drawn from the foregoing data. Future studies may add to and/or change these conclusions.

1. A confined aquifer exists beneath the site with a potentiometric surface between approximately 42 to 45 feet below ground level.
2. The general direction of groundwater flow is to the south-southwest.
3. Relatively low permeability soils were encountered from the surface to approximately 10 feet below ground surface. A second low permeability zone was encountered at approximately 25 to 30 feet below ground surface.
4. Based on the chemical data presented in this report, there is no evidence that leakage of pond number 1 has occurred.

5. The elevated levels of chrome and copper detected under the pond appear to have been due to leakage from the old tank area.
6. Waste from the old tank area migrated vertically through the vadose zone to the base of the 30-foot sand and then laterally under the pond.

   no samples taken below 30' in old tank area
7. Elevated levels of nitrates in the water appear to be migrating onto the site from the north.
8. Elevated levels of copper in the soil exist near MW-11.
9. Elevated levels of organic chemicals in the water exist beneath the site. As discussed in Section 10.1, the source of these chemicals are unknown.

12.0 RECOMMENDATIONS

Mitigation of the contaminated soil and groundwater should commence immediately upon approval of the regulatory agencies. Prior to regulatory approval, a mitigation plan should be submitted which includes, at a minimum, the following:

- Design of the optimum groundwater extraction system.
- Design of the optimum groundwater treatment system.
- Soil mitigation options.
- Sampling protocol and frequency.
- Projected time of completion.

Concurrently with submittal of the mitigation plan, pilot groundwater and soil treatment studies should commence.

The pilot groundwater mitigation system will consist of a low volume (10 - 20 gpm) extraction well coupled to a water treatment system. The inorganic compounds will be treated by the existing wastewater treatment system and the organic compounds treated by use of a portable granular activated carbon unit. The objectives of this pilot study will be to determine if the organic compounds can be treated economically by carbon and to determine the extractability of the high levels of chrome in the vicinity of the extraction well.

The pilot soil system will consist of laboratory-packed column tests to determine leaching ability of different substances.

13.0 REFERENCES

The references used in the preparation of this preliminary report include, but are not limited to, the following:

1. U.S.G.S. Topographic Map, Whittier Quadrangle, 1981.
2. DWR Bulletin 104, Appendix A.
3. Division of Water Rights, map, Location of Water Wells.
4. Wastemaster Service Central Basin, Los Angeles County, July 1, 1981 - June 30, 1982.
5. Watermaster Service Central Basin, Los Angeles County, July 1, 1982 - June 30, 1983.
6. DWR Bulletin 8.
7. DWR Bulletin 63, Appendix A.
8. Report on TCE Investigation, Los Angeles Regional Water Quality Control Board, April, 1980.

9. Coastal Plain Ground Water Contours, Shallow Aquifer, Los Angeles Flood Control District, map no. 2-H240, Fall, 1975.

10. Southern California Chemical, Inc. records.

11. Rouse and Pyrih, (1985) "International Conference on New Frontiers in Waste Management."

13.0 LIMITATIONS

The conclusions and recommendations in this report are based on:

1. The 19 test borings performed at this site.
2. The observations of our field personnel.
3. The results of laboratory tests performed by Brown and Caldwell Analytical Laboratories and Southern California Chemical, Inc.
4. The results of the land surveying conducted by Combs/Rodriguez & Associates Land Surveying.
5. Measurements of groundwater elevations in the 13 monitoring wells.
6. Referenced documents.

It is possible that variations in the soil or groundwater conditions could exist beyond the points explored in this investigation. Also, changes in the groundwater conditions found could occur at some time in the future due to variations in rainfall, temperature, regional water usage or other factors. The services performed by J. H. KLEINFELDER & ASSOCIATES have been conducted in a manner consistent with the level of care and skill ordinarily exercised by members of our profession currently practicing under similar conditions in the Los Angeles County area. No other warranty, expressed or implied, is made.

Respectively submitted,

J. H. KLEINFELDER & ASSOCIATES

Kenneth L Durand

Kenneth L. Durand
Hydrogeologist

Randolph C. Harris

Randolph C. Harris
Senior Hydrogeologist
R. G. #3708

KLD/RCH:gw

	MW 1		MW
	B&C	RWQCB	B&C
1,1 Dichloroethane	Not Sampled		
1,1 Dichloroethylene			
Benzene			
Carbon Tetrachloride			
Chloroform			
Ethylbenzene			
Methylene Chloride			
Trichloroethylene			
Toluene			
trans-1,2-Dichloroeth			
Phenols			
Perchloroethy			
1,2 Dichl			
Semi-			

MW 5

RWQCB

1.0

1.1

B&C

Not Sampled

MW 6

RWQCB

0.9

24

7